

# WATER DESALINATION REPORT

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## Singapore

### BID RESULTS FOR PUBS 4<sup>TH</sup> DESAL PLANT

On 8 September, seven bidders submitted proposals for PUB's Marina East Desalination Project. The project, which will produce 136,380 m<sup>3</sup>/d (36 MGD) of potable water from two different sources, seawater from the Singapore Strait and relatively fresh water from the Marina Reservoir, will be delivered under a 25-year DBOO contract.

The base bid results, excluding alternate offers, are:

Bidder	\$\$/m <sup>3</sup>	\$/m <sup>3</sup> (\$/kgal)
Shanghai Safbon Water Service / Yongnam Development / UE NEWater	0.76	0.56 (2.12)
Hyflux / Daelim Industrial	1.09	0.80 (3.03)
Keppel Infrastructure Holdings	1.18	0.87 (3.29)
MCC Land / IDE Technologies	1.22	0.89 (3.37)
Singapore Technologies Marine / Acciona Agua / Lum Chang Building Contractors	1.22	0.89 (3.37)
Tedagua	1.40	1.03 (3.90)
Sembcorp Utilities	1.43	1.05 (3.97)

The above are considered 'first year' tariffs, which *WDR* understands reflect the price at which the contractor will agree to sell water to PUB during the first year at full capacity. After the first year, several indices come into play and the cost will be adjusted accordingly.

The plant includes some requirements that are unique among Singapore's desal projects. Besides the ability to deal with varying salinities from two very different feedwater sources, it must have a minimum 98 percent availability with no outage affecting the entire plant for more than five hours, and no more than one outage occurring in any 168-hour period.

Because it will be located on an unfenced, 3ha (7.4 acre) site in a public park with open access to the plant's green roof, it will also face some unique architectural and security challenges.

The bid evaluation, now underway, will consider the technical qualifications and anticipated costs over the life of the project to develop a levelized cost that will determine the successful bidder.

Black & Veatch is serving as the PUB's technical advisor on the project, and it is expected to come online in 2019.

## Texas

### BWRO BID RESULTS ANNOUNCED

Four offers were submitted in response to an RFP called by Fort Bend County's Cinco Municipal Utility District #1 for a 2 MGD (7,570 m<sup>3</sup>/d) BWRO treatment system. The results of the bid opening held this past Friday, 16 September, are as follows:

Bidder	Total Price
H2O Innovation	\$2,976,850
Doosan Hydro Technology	\$3,200,680
United Water Services	\$3,747,345
Aerex Industries	\$4,579,673

The scope of work includes an operational RO system including chemical feed units, RO process controls, a degasifier and the transfer pump station pumps.

The project is to be delivered under a traditional design-bid-build delivery model, and an award could be made as early as the end of this week. The plant is expected to be operational within 16 months of an award.

Brown & Gay is the District's engineer and NorrisLeal is the plant designer and project construction manager.

## Virginia

### AQUIFER REPLENISHMENT PROJECT LAUNCHED

Last week's national *Imagine a Day Without Water* event—organized in the US by a coalition of public and private water agencies, business/community leaders and national organizations—served as a stage for announcing new water programs across the country. One such program was the Sustainable Water Initiative for Tomorrow (SWIFT) launched by southeast Virginia's Hampton Roads Sanitation District (HRSD).

HRSD operates 13 wastewater treatment plants with a combined capacity of 249 MGD (942,500 m<sup>3</sup>/d) in a service area that includes 1.7 million people living in over 2,800 mi<sup>2</sup> (7,252km<sup>2</sup>) of southeast Virginia. SWIFT is designed

### Next Week: Texas Desal 2016

The Texas Desal Association will hold its annual conference next week, on 29-30 September, in Austin, Texas. For more information, visit [www.texasdesal.com/events/2016-conference/](http://www.texasdesal.com/events/2016-conference/).



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to establish a secure groundwater supply while improving water quality in local rivers and the Chesapeake Bay. To accomplish this, plans call for wastewater effluent that would otherwise be discharged into area waterways to undergo advanced treatment to meet drinking-quality standards. The purified water would then be treated to match the existing groundwater chemistry before being used to replenish the Potomac Aquifer, the area's primary water supply.

As part of its *Imagine a Day Without Water* observance, the HRSD celebrated the preliminary success of its SWIFT pilot project at its York River Treatment Plant with a taste test. According to Dr Charles Bott, the District's director of water technology and research, "The pilot project is evaluating two different drinking water treatment schemes that are treating denitrified secondary effluent from the York Plant. The first treatment arrangement consists of UF/RO and advanced oxidation, while the second employs flocculation/sedimentation, ozonation, biofiltration, granular activated carbon and UV disinfection. The two systems produce a combined 20 gpm [1.3 L/s]."

The results of this pilot project will be used to select an appropriate technology to be used in a larger, 1 MGD (3,785 m<sup>3</sup>/d) demonstration project planned for the HRSD Nansemond Treatment Plant in Suffolk, Virginia. The facility will then treat the water to match the existing groundwater quality before testing its ability to pump water into the aquifer. The results of groundwater replenishment will be monitored for year.

HRSD expects to begin construction of the first full-scale facility in 2020. It estimates a 10-year construction schedule to reach build-out of the full-scale \$1 billion project to produce approximately 120 MGD (454,200 m<sup>3</sup>/d) of purified water by 2030.

CH2M is serving as the District's consultant on the project.

## Caribbean

### POINT LISAS BACK ON-LINE

Since it was commissioned in early 2002, Desalco's Point Lisas SWRO plant in Trinidad has been expanded six times, with its production capacity increased from 26.4 MGD

(22 MIGD) to 50.4 MGD (42 MIGD). Because the plant produces 20 percent of the island's water supply, there is very limited storage capacity at the national level and as the area is currently experiencing an extended drought, any plant shutdown garners a lot of attention.

Desalco general manager John Thompson told *WDR*, "The plant is now 14 years old and there is an ongoing program to inspect our many large underground pipes. Our last video and sensor checks showed some signs of aging, and although we scheduled repairs, there didn't appear to be any immediate problem. However, last Sunday [11 September], a deeply buried section of the 48-inch [1.2m] diameter distribution pipe unexpectedly collapsed.

"The plant was shut down for emergency repairs on Monday afternoon and the public was promptly notified of the situation. We were able to finish the repairs and get the plant back on line by Wednesday evening, and by Thursday morning, it was ramped up to full ordered capacity."

## Technology

### THE LAW OF DIMINISHING RETURNS

Promises of desalination energy reductions of 100X or more seem to have started in 2006 with early work involving the use of carbon nanotubes as a super- or ultrapermeable membrane (UPM). Subsequent research in membrane coatings, nanocomposites, aquaporins and graphene have resulted in advertised promises that flux increases of 1000X are possible, with one company claiming to have developed a shoebox-sized desalination module that could desalt 100,000 gpd (378 m<sup>3</sup>/d) at one-third the energy of a conventional RO.

A 2014 MIT paper entitled "*Quantifying the potential of ultra-permeable membranes for water desalination*" threw some cold water on the most outlandish claims by showing that the benefits of UPMs for reducing energy consumption are limited to 15 percent in the case of SWRO.

Now, a new MIT paper—"On the asymptotic flux of ultra-permeable seawater RO membranes due to concentration polarization", by Ronan McGovern and John Lienhard, and published online in Elsevier's *Journal of Membrane Science* in July 2016—shows that, even with infinitely permeable membranes, there are finite limits on the flux that can be achieved.

According to the paper, increasing membrane permeability (at fixed pressure) results in increased flux, which in turn results in an increased concentration of salt at the membrane's surface, a phenomenon known as concentration polarization. As membrane permeability continues to increase, flux becomes limited because the osmotic pressure at the membrane surface eventually reaches the applied hydraulic pressure. The paper goes on to illustrate where limits on flux



Wigen Water Technologies' RO pilot unit

lie relative to typical values seen in seawater and brackish water systems today.

“While there’s little room for improvement in energy consumption, there is still substantial room for flux improvement,” Dr McGovern told *WDR*. “For a single stage SWRO system operating at a typical pressure, recovery ratio and mass transfer coefficient, the flux asymptote is roughly four times where average flux currently stands. The most significant benefit of a system operating at the higher flux would be its smaller footprint and lower CapEx, although implications for fouling and scaling would also have to be assessed.”

UPMs will not result in 100X less energy or 100X higher flux, however, of the two, there is greater hope for a significant increase in average flux, than a decrease in energy consumption.

### Company News

#### ELECTRO-DESAL FIRM CLOSES FUNDING ROUND

Netherlands-based Voltea, the developer of the CapDI® membrane capacitive deionization technology, has announced that it has completed a €6 million (\$6.7 million) capitalization round. For this latest round, Anterra Capital has joined a consortium of previous investors that includes Rabobank, ETF and Unilever.

Besides helping to accelerate commercialization of the CapDI technology, the investment will be used to hire key personnel and develop an automated, robotic module assembly facility. CEO Bryan Brister told *WDR* that the new engineering and sales associates will be located in North America to complement its strong Netherlands-based team.

“We will continue to build on markets where CapDI has already gained commercial traction. These include TDS control/polishing in wastewater treatment and recycling applications in commercial laundry, food and beverage and automotive industries, as well as novel TDS control systems we are deploying for irrigation water in horticulture applications,” said Brister.

“Our global team will continue to execute our go-to-market strategy, which includes a mix of sales through distributors as well as direct sales to end-use customers. We have been fortunate to add some great, forward-thinking distributors that are bringing CapDI to the market for consideration versus traditional desal technologies.”

The company is expected to announce details of the new assembly plant in the near future.

*Editor’s note:* Voltea’s CapDI technology was the winner of GWI/*WDR*’s 2010 Technology Idol event in Paris.

### Technology

#### WHERE’S THE OLDEST OPERATING RO PLANT?

Eight years ago, *WDR* covered the decommissioning of Qatar’s Ras Abu About MSF plant. The plant had been in continuous service since it was built and commissioned by Weir in 1963. In checking on other long-lived thermal desal plants, *WDR* found another Weir installation in Qusair, Egypt that had been installed in 1936 and was still seeing intermittent service until at least 1986. A third Weir plant installed in Yemen’s Aden Refinery in 1955 was still making water when that January 2008 story was written.

Although this newspaper has written about the first commercial, BWRO plant (Coalinga, California, 1965) and the first SWRO plant (Bermuda Aviation, 1974), and has covered some long-running membrane plants, it has not yet identified the longest running RO plant still in commercial operation.

Last week, *WDR* reached out to several veteran desalters in hopes of finding the oldest operating RO plant. While several worthy contenders have been identified, the search is still on to confirm the details of the following plants:

- *Malta* – The Ghar Lapsi plant, which was the first SWRO plant on Malta and a gift from Saudi Arabia, was commissioned on 31 December 1982. The plant has been refurbished several times and remains in service.
- *Saudi Arabia* – The Al Birk SWRO plant was installed in 1983 and, after having been refurbished, remains in operation.
- *Florida Keys Aqueduct Authority* – This SWRO plant was commissioned in January 1981 on Stock Island. After 18 months of operation, the plant was placed in standby operation and part of the plant was eventually relocated to Marathon, Florida. Both plants are available for emergency operation. In 2007, water produced from the Stock Island plant won a statewide taste test.

Readers are invited to submit confirmed information on any other plants that were commissioned in 1986, or earlier, that are still in service.

The results will be profiled in more detail in a future issue.

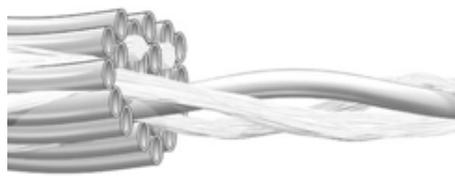
### IN BRIEF

Ten companies are understood to be eligible to participate in the tender process for Econssa’s 38,880 m<sup>3</sup>/d (10.3 MGD) **Agua Chañar SWRO plant** on Chile’s central coast. The project will include 11 new pumping stations and 75km (47 mi) of pipelines. The companies are Abengoa/Abeima,

Acciona Agua/Acciona Infraestructuras, Besalco/Aqualia, Degrémont (Suez), Dragados/Tedagua, Ferrovial/Cadagua, GS Inima/Claro Vicuña, IDE Technologies, Técnicas Reunidas/INTEC and Valoriza/Sadyt. The tender process is expected to commence this December.

**Water Standard** is adding another dimension to offering. Lisa Henthorne, the chief technology officer for the Houston-based water treatment technology provider, told *WDR*, “Given the work that our personnel have delivered—ranging from large-scale desalination systems to innovative, low salinity injection water systems for the oil and gas industry—we are uniquely positioned to offer specialized consulting and product development services.” She said interested parties are welcome to contact her for more information.

**3M Membrane Business Unit** will introduce its new Liqui-Flex UF membrane module at next week’s WEFTEC in New Orleans, Louisiana. The new module will have 96m<sup>2</sup> (1,033 ft<sup>2</sup>) of membrane surface area in a single module versus the 91m<sup>2</sup> (980 ft<sup>2</sup>) in the largest module currently available. The module incorporates the same 0.8mm diameter inside-out polyethersulfone (PES) hollow fibers, groups of which are interlaced with PET yarn that acts as a spacer between the small fiber bundles to improve backwash hydrodynamics. 3M Membrane Business Unit was formerly known as Membrana GmbH, and was acquired by 3M in August 2015.



**STW Resources**, an oilfield services company and ersatz water treatment equipment supplier based in Midland, Texas, has filed for Chapter 11 of the Bankruptcy Code, said Alan Murphy, the company’s president and CEO. The company was founded by Stanley Wiener, who stepped down as president and CEO in October 2015. It had been an OTC stock that traded under the symbol STWS.

Saudi Arabia has acknowledged that it will return to private finance for greenfield desalination projects. In mid-2015, seven bidders were prequalified by SWCC to participate in the 400,000 m<sup>3</sup>/d (105.7 MGD) **Jeddah 4 SWRO project** on an EPC basis, and an RFP was issued in October 2015,

however, the project was put on hold earlier this year as the water sector underwent major restructuring. The on-again, off-again project appears to be on again, and will move forward as an independent water project (IWP), necessitating a new tender process. The bidders prequalified in 2015 were Acciona, Aqualia, Cadagua, Doosan, Hyflux, Valoriza and Veolia. Black & Veatch served as SWCC’s project engineer. The country’s last IWP/IWPP contract was awarded in 2007.

Three suppliers have been shortlisted by the UAE’s **Sharjah Electricity and Water Authority** (SEWA) to supply a 22,730 m<sup>3</sup>/d (6 MGD) SWRO at its Layyah Plant. The shortlist is understood to include Aqua Engineering/Tecton, Aqualyng/Acwa Emirates and Metito. This project will double the size of the Layyah’s SWRO capacity. CH2M installed and commissioned an identically sized system at the facility in August 2008.

Prequalification submissions for developers interested in participating in PUB’s **Jurong Island desalination project** are due on 29 September. The 136,380 m<sup>3</sup>/d (36 MGD) SWRO project will be delivered under a 25-year DBOO contract, and it will be Singapore’s fifth large-scale desal plant. The plant is expected to be operational in 2020, and CH2M has been selected as PUB’s consultant.

## PEOPLE

**Aadel Ben Brahim** has joined Danfoss High Pressure Pumps, where he will be the global service and application specialist for the company’s high-pressure pump and energy recovery products. Formerly a service engineer at Energy Recovery Inc, he is located in Spain and may be contacted at [U326815@danfoss.com](mailto:U326815@danfoss.com).

Bechtel Corporation has appointed **Felipe Suarez** as the business development manager for water sales. He was formerly the head of global sales for Siemens Water. He will be based in Houston, Texas, and may be contacted at [fjsuarez@bechtel.com](mailto:fjsuarez@bechtel.com).

**Shil Basu** has joined Water Planet as global director of sales for its PolyCera membrane products. He had formerly held technical, commercial and leadership roles for Siemens Water (now Evoqua), Nalco Champion and, most recently, Hydranautics. He is based in Los Angeles, California, and may be contacted at [sbasu@waterplanet.com](mailto:sbasu@waterplanet.com).